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United States Department of Agriculture | Forest Service | San Juan/Rio Grande National Forest | 1803 W. Highway 160, Monte Vista, CO 81144, (719) 852-5941

Reply to: 2520

Date: January 5, 1995

Enclosed is the white paper describing the Rio Grande National Forest's approach to watershed analysis that you requested. We appreciate your early review.

Notice that the paper is in draft form. At this point in time it is just a proposal. Comments are welcome and anticipated. The paper and the approach will undoubtedly change some because of comments that we receive.

Comments or questions regarding the paper may be addressed to Les Dobson, Forest Hydrologist, at the address listed above or by calling him at 719-852-6213.

Thank you.

Pam Wilson

PAMELLA L. WILSON
Land Management Planning Asst.

enclosure

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WATERSHED ANALYSIS WHITE PAPER

December 12, 1994

By law, Forest planning must evaluate both existing and potential watershed conditions that will influence soil productivity and water pollution. The Forest Service must also use watershed condition to decide permissible levels of resource use.

The Rio Grande National Forest is proposing a new approach to cumulative watershed impact analysis. The approach would identify watersheds that are sensitive to disturbance (the word disturbance is being used here to describe an activity or incident that would change conditions) and that exceed a disturbance threshold. Management activities would then be limited in those watersheds. The approach is summarized below. Details of how disturbance would be calculated are described after the summary. A table showing the watersheds exceeding the disturbance threshold and a flow chart diagraming the approach are also attached.

WATERSHED ANALYSIS SUMMARY

Disturbance Threshold

The Forest Plan ID team (FPIDT) chose to use high erosion hazard class to define watershed sensitivity. Soils with moderate erosion hazard can be easily mitigated and do not identify any critical sensitivity. Sensitive watersheds would be defined as watersheds with over 70% of the area in high erosion hazard class.

There is no well-established scientific basis for defining watershed sensitivity. WRENSS (An approach to Water Resources Evaluation of Non-Point Silvicultural Sources) deals with sensitivity to mass movement and has been incorporated into the Forest Plan Revision. WRENSS was made an official handbook by agreement with the Environmental Protection Agency in 1985. The FPIDT felt a need to go beyond WRENSS in order to capture watershed sensitivity to total disturbance. The definition we are proposing here is based on the professional judgment of our Forest Soil Scientist with agreement from the FPIDT.

A watershed conservation practice being used today is a limitation of no more than 15% of an area in a disturbed condition. This practice will be carried forward into the Forest Plan Revision. The watershed disturbance threshold would be consistent with

this conservation practice. The Rio Grande will consider a watershed unacceptably disturbed if over 15% of it is in a disturbed condition. Sensitive watersheds will be limited to 10% disturbance. The selection of 10% as the threshold for sensitive watersheds was the result of FPIDT discussion and consensus.

Forest watersheds were delineated following the Hydrologic Unit Code system of the U.S. Geological Survey. These guidelines establish levels of watersheds -- the higher the level, the smaller the watershed area. Watersheds analyzed for forest planning will usually be 6th level. In some cases, 7th-level watersheds will be used in order to analyze smaller land units. In a few cases, watersheds chosen for analysis will still be greater than 10,000 acres in size.

The larger the watershed the easier it is to mask or dilute disturbances. Watersheds over 10,000 acres in size but not currently exceeding the disturbance threshold will be broken down into the next higher level watershed for analysis before new activities are allowed. This will ensure that smaller parts of the larger area do not exceed the threshold.

Watersheds analyzed for Forest planning will have closer scrutiny at the project level. Watersheds will be treated appropriately based on whether the more detailed project level analysis shows the disturbance threshold being exceeded or a stream health problem.

Management Limitations

Management limitations will be applied to watersheds exceeding the disturbance threshold. If timber harvest has been identified as the major contributor to overall disturbance, more harvest will be delayed until adequate recovery has occurred. This timing limitation will be captured in FORPLAN, the model used to project the allowable sale quantity. The timing limitation can be waived if enough road acreage, or other disturbances, are available to reduce percent disturbance to an acceptable level and necessary reclamation work is completed. Watersheds identified as exceeding the threshold after approval of the Forest Plan will also have a timing limitation applied to timber harvest although it was not captured in FORPLAN.

Watersheds that exceed the disturbance threshold will have a stream health survey (explained below) completed before any new activity is considered. If stream health has been impaired, no new activity will be allowed until a Watershed Improvement Needs (WIN) inventory has been completed and required reclamation work is accomplished. However, the proposed activity could be allowed if it will be isolated from the stream system or all water quality impacts from the activity are fully mitigated. Even if the activity can be isolated from the stream system, total disturbance cannot be increased if the threshold has already been exceeded. New disturbance must be offset by equivalent restoration acreage. If stream health has not

been impaired, new activities will be allowed as long as standard mitigation is used and total disturbance is not increased beyond the threshold.

All watersheds exceeding the disturbance threshold will be scheduled for a WIN inventory. Necessary work to reduce total disturbance to acceptable levels will be accomplished using funding from appropriate Forest Service programs. If the WIN inventory identifies system road problems, road maintenance will do necessary work. If livestock grazing is causing part of the problem, the range program will do necessary work to help reduce total disturbance. Watershed improvement dollars will also be used when appropriate.

There will be cases where stream health has been impaired even though total watershed disturbance does not exceed the threshold. Project proposals that require an Environmental Analysis will trigger a stream health survey. When stream health problems are identified, watershed activities will be limited as described above.

Stream health surveys will be conducted by collecting stream data that can be compared to reference stream conditions. Reference streams have been selected on the Forest. They are the least impacted streams available and cover broad stream classes. As more suitable streams are found, they will be added to the list of reference streams.

DISTURBANCE COMPUTATIONS

The Forest has been using the HYSED model to do cumulative impact analysis. One criticism of HYSED is that it only models impacts from roads and timber harvest.

For the Forest Plan Revision, the R2 Regional Office has recommended using a watershed percent disturbance approach to cumulative impacts analysis. The Rio Grande NF will implement such an approach. To do this, all activities that cause land disturbance or are potential sources of water pollution will be considered.

Cumulative impact analysis requires the ability to project impacts into the future and to decide how much impact is acceptable. A complication that must be dealt with is how to relate one kind of impact to another.

The Shoshone National Forest (along with the R2 Regional Office) devised a way to add disturbance acreages from different kinds of disturbance. This was done by using a disturbed area factor for each kind of disturbance encountered. This resulted in total disturbed acres by watershed.

The Rio Grande NF borrowed from Shoshone National Forest work for this approach. The following explanations are for disturbed area factors used in the Forest Plan Revision. Disturbed area factors will be updated as better data becomes available.

All disturbed area factors (DAF's) are based on hydrologic soil groups (HSG's) and runoff curve numbers (RCN's). Soil survey data documents that most Forest soils have hydrologic soil group B. For the Forest Plan Revision level of analysis we have derived DAF's for that soil group.

A curve number is an empirical rating of the hydrologic performance of a soil and associated vegetative cover and shows a relative value in producing runoff. Runoff curve numbers have been derived for a variety of soil, vegetative cover, and land management complexes.

RCN's were originally developed to simplify a Soil Conservation Service (SCS) storm runoff volume equation that read:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

where Q = direct runoff, inches
and P = storm rainfall, inches

S = maximum potential difference between P and Q at time of storm beginning and is a function of the soil-cover complex and antecedent soil moisture from previous rainfall.

To go from the equation to RCN's the SCS showed that RCN = 1000/(10+S). The higher the RCN, the more water will run off a site.

Region 2 has also accepted the 10-year, 24-hour precipitation event as the natural event that ground or hydrologic conditions must be able to assimilate. In other words, activities, other than roads and similar facilities, will be designed so that ground conditions can absorb this precipitation event. A curve number of 70 will ensure that this happens. So any curve number less than 70 will be assumed to be acceptable and will not have an assigned DAF. A RCN of 70 or greater will represent a disturbed area that contributes to the 15% or 10% threshold.

Roads are considered the most impacting disturbance, since they eliminate all vegetation and completely compact the surface. All other disturbances are compared to a road by developing DAF's as a ratio to roads. The DAF for a road is 1.0.

From the SCS National Engineering Hydrology Handbook, dirt roads on hydrologic soil group B soils have an RCN of 82. "S" solved for an RCN of 82 is 2.19. From the same source, rangeland in poor hydrologic condition has an RCN of 79 ("S" = 2.66). A DAF for poor range is derived from the ratio 2.19/2.66, or 0.8. Acres of rangeland in poor hydrologic condition can then be multiplied by 0.8 and added directly to road acreage to get a total disturbance area. This procedure has been done for all disturbances encountered on the Forest.

DAF rationale by disturbance type:

Timber Harvest

Research at the Fraser Experimental Forest has shown that tree cutting alone is generally not a sufficient disturbance to cause water quality concerns. The exception is when so many trees are cut that increased streamflow causes streambank erosion. Water quality problems come from associated roads and skid trails. Disturbances for timber harvest included roads and skid trails.

About 30% of old clearcuts have been impacted by roads and skid trails based on aerial photo review. Clearcut areas have been multiplied by 0.3 to get an equivalent disturbed area associated with them.

Partial cuts also have had ground disturbance but less than clearcuts. Data has been collected on the Pool Table timber sale area, Divide Ranger District, Rio Grande NF, according to the Soil Management Handbook. This timber sale was

the second step of a shelterwood cut. Nineteen percent of the area analyzed was in a disturbed condition that contributed toward the 15% soil disturbance threshold. These are not necessarily equivalent road disturbances but represent the best data right now on the amount of disturbance associated with past partial cuts. Projected disturbance for future cuts will be 10%, based on what experience says should be achievable for conventional equipment. (personal communication, John Rawinski - Forest Soil Scientist).

No recovery is assumed for these disturbances over time. This is for two reasons. One is that for clearcuts we are only including the percentage of roads observed via aerial photos. Roads typically do not fully recover without some investment to restore condition. The other reason is that the 19% for other types of cuts is based on actual data collected on an area of past harvest.

Forest to grass

It would only take 55% ground cover of herbaceous vegetation to have a curve number of 70 for hydrologic soil group B. It seems reasonable to assume that forested areas converted to grass will have at least 55% ground cover. So for this level of analysis, forest converted to grass will not contribute to equivalent disturbed area.

Pipeline

Disturbed areas from pipeline installation will also be assumed to have revegetated to at least 55% ground cover with no contribution to equivalent disturbed area.

When trees are cut, streamflow is increased. Increased streamflow is also a disturbance that should be accounted for. To be consistent with all other disturbances, the disturbance from increased flows must be related to the disturbance caused by a road. The amount of sediment coming from an acre of road was estimated and compared to the same amount of sediment coming from increased streamflow as a result of timber harvest. The amount of tree removal needed to produce that amount of streamflow was then calculated.

Most Forest roads are estimated to produce about 0.25 tons of sediment per acre of road. The HYSED model estimates that five equivalent clearcut acres will produce enough additional flow to increase sediment by 0.25 tons. Equivalent clearcut acres were determined from the disturbance table and divided by five to get an equivalent road disturbance associated with increased runoff.

Other disturbances, such as heavy use sites, milling sites, impoundments, ditches, railroads, abandoned dumps, etc. were equated directly to a road and were given a DAF of 1.0.

When all disturbance acreage is multiplied by the appropriate DAF and then added together, total equivalent disturbance acreage can be compared directly between watersheds. This has been done for all 6th, and in some cases 7th, level watersheds on the Forest that have had a high amount of activity. These watersheds have been ranked by highest to lowest percent disturbed area.

The attached table gives the highest ranked watersheds and those that exceed the disturbance threshold.

The Forest is also getting inventory data from the state of Colorado on problems related to past mining. The Forest will identify areas where environmental problems exist because of mining activity and describe how those problem areas will be restored.

Ultimately, we will need to relate total disturbance to stream health impacts. This will require collecting field data on reference streams which specialists will then compare to the same types of data from study (impacted) streams. When unacceptable impacts, or deviations from reference conditions are seen, those impacts will be related to total percent disturbance connected to the stream system. This type of data collection and analysis will be detailed in the monitoring section of the Forest Plan.

Key to this effort will be identifying what unacceptable deviations from reference conditions are. The State of Colorado has not been able to identify thresholds for physical and biological stream characteristics. If they ever do, the Forest will need to make sure that minimums are being met or hopefully exceeded. Meanwhile, the Forest will try to identify when significant changes occur based on our best understanding of stream health indicators and how to monitor them.

Priority watersheds identified by the State must be included in our plans. Forest watersheds identified in the State 305b assessments include three watersheds affected by past mining -- Willow Creek, Alamosa River, and Kerber Creek.

RGNF - FOREST PLAN REVISION — 11/17/94

WATERSHED ANALYSIS

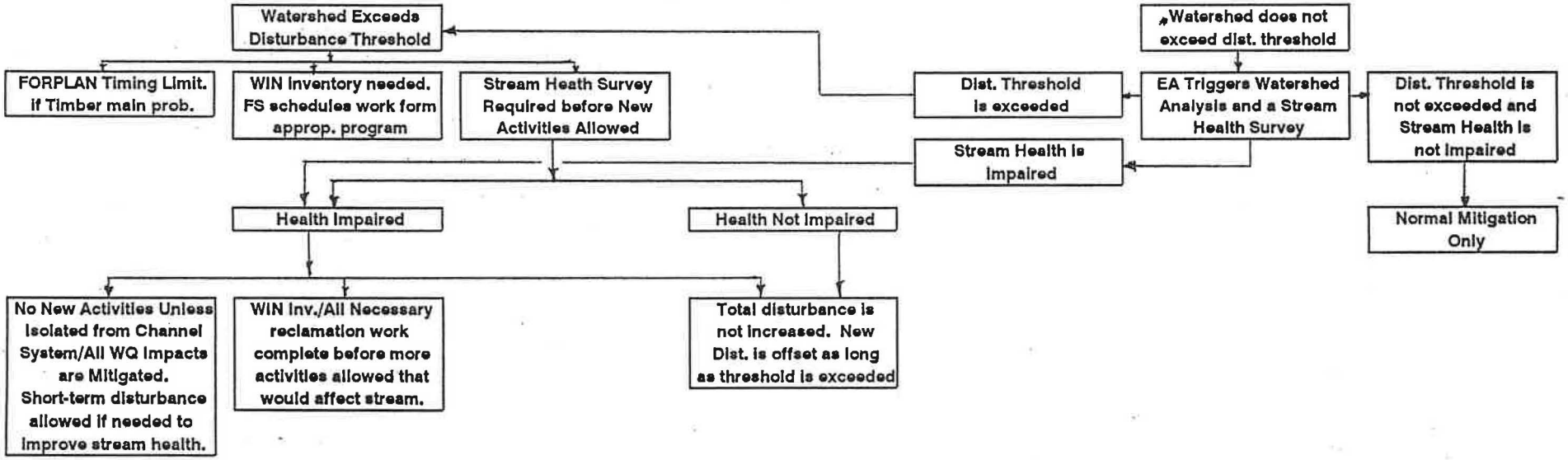
WATERSHED #	STREAM NAME	WS ACRES	% DIST.	% WS HARVEST	ROAD AC.	ROAD DENSITY	% OF WS IN RDS	% HIGH ERO.HAZ	% MOD. ERO.HAZ.	MAJOR PROBLEM
13010004010307	Unnamed Trib. to Sag. Cr.	2071	61	0	24	4	1	70	28	Gullies/Ero.
13010004090103	Miners Cr. (S.Fk. Carnero)	4179	22	12	78	6	2	51	54	Timber/Roads
13010004020201	Moon Cr.	2838	16	13	71	8	3	88	17	Timber/Roads
130100011103	Rio Grande Composite	14798	15	0	283	6	2	73	7	Roads/Subdiv.
13010004020202	Allen Cr.	4405	15	14	128	9	3	88	12	Timber/Roads
13010004090106	Cave Cr.	5979	14	9	122	7	2	86	27	Timber/Roads
130100040202	Saguache Cr.(Allen, Grouse,	14760	12	8	283	6	2	71	25	Tim./Rds./Gul.
130100011201	Alder Cr.	13728	11	9	303	7	2	76	14	Timber/Roads
13010001130501	Upper Park Cr.	7536	15	19	113	5	2	7	83	Timber/Roads
130100011303	Pass Cr.	14165	14	15	168	4	1	33	61	Tim./Rds./Rng.
13010003020106	Slaughterhouse Cr.	2405	14	9	12	2	0	10	55	Tim./Rds./Gul.
130100010603	Workman Cr.	1179	13	16	11	3	1	42	54	Timber/Roads
13010004100201	Perry Cr.	2823	13	13	44	5	2	18	85	Timber/Roads
130100040804	Boland, Laughlan Gulch	6042	12	1	27	1	0	50	10	
13010004090101	South Fork Carnero Cr. (Upp	4660	12	4	99	7	2	51	38	
130100040103	Middle Fork Sag. Cr.	24574	12	0	98	1	0	49	28	
13010001020302	Mason Cr.	2851	11	6	30	3	1	66	38	
130100040901	South Fork Carnero Cr.	28201	11	5	394	4	1	58	39	
130100010802	West Willow Cr.	12208	11	0	172	5	1	31	39	
130100040201	Bear Cr. (Sag.Cr.Trib)	10299	10	6	180	6	2	51	44	
13010001060702	Lime Cr.	7774	10	7	98	4	1	46	37	
130100010502	Middle Cr. (Creede)	5096	10	12	28	2	1	5	74	
13010003020101	Kerber Cr. Upper	3315	10	7	16	2	0	17	71	
130100040404	Taylor Canyon	4859	10	7	35	2	1	44	37	
130100040104	S.Fork Sag. Cr.	28646	9	0	165	2	1	51	38	
130100040301	West Park/Hot Sprgs Cr.	10836	9	6	137	4	1	38	28	
13010001150501	Shaw Cr.	2045	9	7	54	8	3	70	17	
130100040601	Jack's, Vulcan Crs.	3574	9	6	41	4	1	17	68	
130100040403	E.Pass Cr.	9325	9	6	112	4	1	26	53	
130100011101	Blue Cr.	7871	8	7	118	5	2	70	24	
13010002040101	Trib. to S. Fork Rock Cr.	1354	8	7	32	7	2	23	95	
130100030101	Clover Cr.	5003	8	1	46	3	1	10	61	
13010004090201		5203	8	8	74	5	1	45	56	
130100040902		11538	8	6	205	6	2	48	51	
13010001130703	Cross Cr.	6534	8	10	31	2	0	74	16	
130100011304	Lake Fork Cr.	6736	8	4	99	5	1	15	82	
130100011305	Park Cr.	26271	8	9	268	3	1	47	44	
130100040205	Luders, Jakes, Cantonment, B	14826	8	5	99	2	1	69	27	
130100010801		13325	8	0	34	1	0	70	16	
13010001020108	Corral Cr.	1204	8	6	23	6	2	59	0	

ORDERED BY PERCENT DISTURBANCE AND ADJUSTED FOR THRESHOLD

THRESHOLD:>15 AND >10 FOR SENSITIVE WSs

SENSITIVE WSs = >70% OF AREA IN H.ERO.HAZ. CLASS

WATERSHED ANALYSIS
FLOW CHART
12/9/94


Watershed Exceeds Disturbance Threshold
Watershed does not exceed dist. threshold
FORPLAN Timing Limit. if Timber main prob.
WIN Inventory needed. FS schedules work form approp. program
Stream Heath Survey Required before New Activities Allowed
Dist. Threshold is exceeded
EA Triggers Watershed Analysis and a Stream Health Survey
Dist. Threshold is not exceeded and Stream Health is not Impaired
Stream Health is Impaired
Health Impaired
Health Not Impaired
Normal Mitigation Only
No New Activities Unless Isolated from Channel System/All WQ Impacts are Mitigated. Short-term disturbance allowed if needed to improve stream health.
WIN Inv./All Necessary reclamation work complete before more activities allowed that would affect stream.
Total disturbance is not increased. New Dist. is offset as long as threshold is exceeded

WATERSHED ASSESSMENT
A White Paper for Forest Plan Revision
10/22/96

By law, Forest planning must evaluate the influence of watershed condition (existing and potential) on soil productivity and water pollution. The Forest Service must also use watershed condition to determine permissible levels of resource use.

The Rio Grande NF is initiating a new approach to watershed assessment with the Forest Plan Revision. In the past we have used a model (HYSED) to predict sediment delivery loads and compare those to a threshold that varied by stream type. Models cannot account for all the natural variation that exists between watersheds and because of this natural variation, an absolute threshold does not exist.

The new approach will 1) identify watersheds that are sensitive to disturbance (the word disturbance is being used here to describe an activity or incident that would change conditions), and 2) assess disturbance by comparing it to risk levels that identify watersheds of concern. Watersheds of concern require a more detailed assessment to see if stream health has been impaired and identify restoration needs. The approach is summarized below.

WATERSHED ASSESSMENT SUMMARY
Background

Healthy watersheds protect water quality and provide sustainable ecosystems. Watersheds and streams can retain a healthy balance with some resource use and disturbance. The Rio Grande National Forest intends to manage disturbances through a watershed by watershed assessment. Different levels of disturbance, depending on watershed sensitivity, will be used to identify watersheds of concern. Watersheds of concern will be assessed in more detail to see if stream health has been impaired or is being threatened.

Water quality is affected by overall watershed condition and by disturbances that are directly connected to the stream system. Both will be dealt with in the Forest Plan Revision.

Although not discussed in detail here, water quality will also be protected by implementation of conservation practices. Conservation practices will exceed voluntary state best management practices and will be routinely applied.

Watershed Sensitivity

The Forest Plan Interdisciplinary Team (FPIDT) wanted to identify watersheds that are less tolerant to surface disturbance. Disturbances that are acceptable in some watersheds could pose a risk to more sensitive watersheds. Watersheds that are susceptible to mass movement, surface erosion and have a high drainage density are considered by the team to be especially susceptible, or sensitive, to surface disturbance impacts.

High erosion hazard class soils will be used to identify susceptibility to surface erosion. When over 70% of a watershed area is composed of soils with

DISTURBANCE CALCULATIONS

The Forest has been doing cumulative impact analyses using the HYSED model. Criticisms of HYSED include its ability to only model impacts from roads and timber harvest and its prediction of sediment yields based on stream type.

The R2 Regional Office has recommended use of a percent disturbance approach to cumulative watershed impact assessment. Our intention is to implement this approach for the Forest Plan Revision. To do so we will consider all activities that cause land disturbance or are potential sources of water pollution.

Cumulative impact assessment requires the ability to project impacts into the future and to determine how much impact is acceptable. A complication that must be dealt with is how to relate one kind of impact to another.

The Shoshone National Forest (along with the R2 Regional Office) devised a way to add disturbance acreages from different kinds of disturbance. This was done by using a disturbed area factor for each of the different kinds of disturbance encountered. By doing this they were able to get total disturbed acres by watershed.

We have borrowed from the Shoshone National Forest work for this approach. Below are explanations for disturbed area factors used in the Forest Plan Revision. Disturbed area factors will be updated as better data becomes available.

All disturbed area factors (DAFs) are based on hydrologic soil groups (HSGs) and runoff curve numbers (RCNs). Most Forest soils have hydrologic soil group B. For this level of assessment, DAF's have been derived for that soil group. Project level analysis will include a more detailed assessment of HSGs and DAFs.

A curve number is an empirical rating of the hydrologic performance of a soil and associated vegetative cover and shows a relative value in producing runoff. Runoff curve numbers have been derived for a variety of soil, vegetative cover, and land management complexes.

RCN's were originally developed to simplify a Soil Conservation Service (SCS) storm runoff volume equation which read:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

where Q = direct runoff, inches
P = storm rainfall, inches
S = maximum potential difference between P and Q at time of storm beginning and is a function of the soil-cover complex and antecedent soil moisture from previous rainfall.

To go from the equation to RCN's the SCS showed that RCN = 1000/(10+S). The higher the RCN, the more water will run off a site.

This region uses the 10-year, 24-hour precipitation event as the natural event

that healthy ground or hydrologic conditions should be able to assimilate. A curve number of 70 will ensure that ground conditions can absorb this precipitation event. So any curve number less than 70 will be considered acceptable and will not have an assigned DAF. A RCN of 70 or greater will represent a disturbed area that contributes to the risk assessment.

Roads are considered to be the most impacting disturbance, since they eliminate all vegetation and completely compact the surface. All other disturbances are compared to a road by developing DAFs as a ratio to roads. The DAF for a road is 1.0. DAFs for lessor impacts will be less than 1.0.

From the Soil Conservation Service National Engineering Hydrology Handbook (SCS HH), dirt roads on hydrologic soil group B soils have a RCN of 82. "S" solved for a RCN of 82 is 2.19. From the same source, rangeland in poor hydrologic condition has a RCN of 79 ("S" = 2.66). A DAF for poor range is derived from the ratio 2.19/2.66, or 0.8. Acres of rangeland in poor hydrologic condition can then be multiplied by 0.8 and the result added directly to road acreage to get a total equivalent disturbance area. This same procedure was used for all disturbances encountered on the Forest.

DAF rationale by disturbance type:

Timber Harvest

Research at the Frasier Experiment Station has shown that tree cutting itself is not a major disturbance, unless so many trees are cut that increased streamflow causes streambank erosion. Most water quality problems come from associated roads and skid trails.

About 30% of old clear cuts have been impacted from roads and skid trails based on aerial photo review. Clear cut areas have been multiplied by 0.3 to get an equivalent disturbed area associated with them.

Partial cuts have had less ground disturbance than old clear cuts. Data has been collected on the Pool Table timber sale area (second step of a shelterwood) following the Soil Management Handbook. Nineteen percent of the area assessed was in a disturbed condition that contributed toward the 15% soil disturbance threshold. These are not necessarily equivalent road disturbances but represent the best data available on the amount of disturbance associated with past partial cuts. The DAF for partial cuts was 0.19 for this Forest Plan revision assessment. Projected disturbance for future cuts will be 10%, based on what experience says should be achievable for conventional equipment. (personal communication, John Rawinski - RG forest soil scientist).

Recovery is included with these DAFs. For clear cuts we only included the percentage of roads observed via aerial photos, which were taken many years after the area was roaded and harvested. Roads typically do not fully recover without some investment to restore condition. The 19% for other types of cuts is based on actual data collected on a area of past harvest, where recovery was part of conditions measured.

Forest to grass.

It would only take 55% ground cover of herbaceous vegetation to have a curve number of 70 for hydrologic soil group B. It seems reasonable to assume that forested areas coverted to grass will have at least 55% ground cover. So for this level of assessment, forest cover coverted to grass will not contribute to equivalent disturbed area.

Pipeline.

Disturbed areas from past pipeline installation will also be assumed to have revegetated to at least 55% ground cover with no contribution to equivalent disturbed area.

Tree Removal

When trees are cut, streamflow is increased. The Forest has been criticized for acknowledging the benefit of increased water without including any associated impact. There is no fully accepted method for accounting impacts from increased water. Research has shown that impacts from streamflow increases will not be noticable unless 25-40% of basal area is removed from a watershed. Since this is not the case for any Forest watersheds, this impact was not dealt with further.

Other Disturbances

Heavy use sites, milling sites, impoundments, ditches, railroads, abandoned dumps, etc. were equated directly to a road and were given a DAF of 1.0.

When all disturbance acreage is multiplied by the appropriate DAF and then added together, total road equivalent disturbance acreage can be compared directly between watersheds. This has been done for all 6th, and in some cases 7th, level watersheds on the Forest that have had a high amount of activity in the past. These watersheds have been ranked by highest to lowest percent disturbed area.

Appendix K, Land and Resource Management Plan, includes a table with the highest ranked watersheds and those that exceed a risk level.